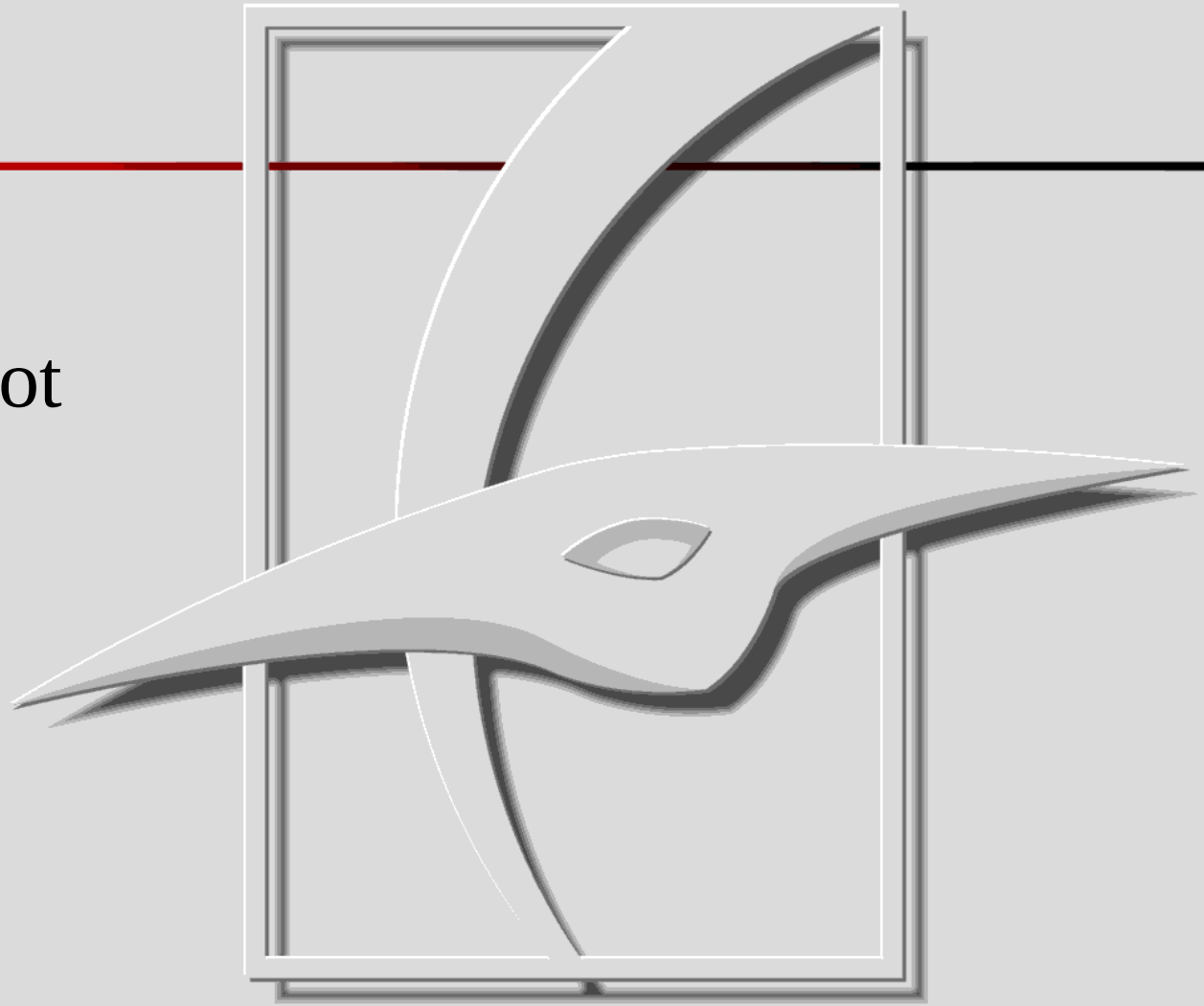
AP209 EA Pilot Scenarios



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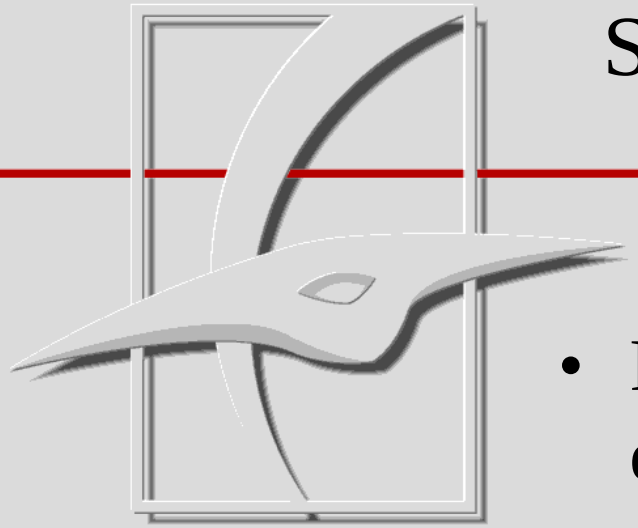
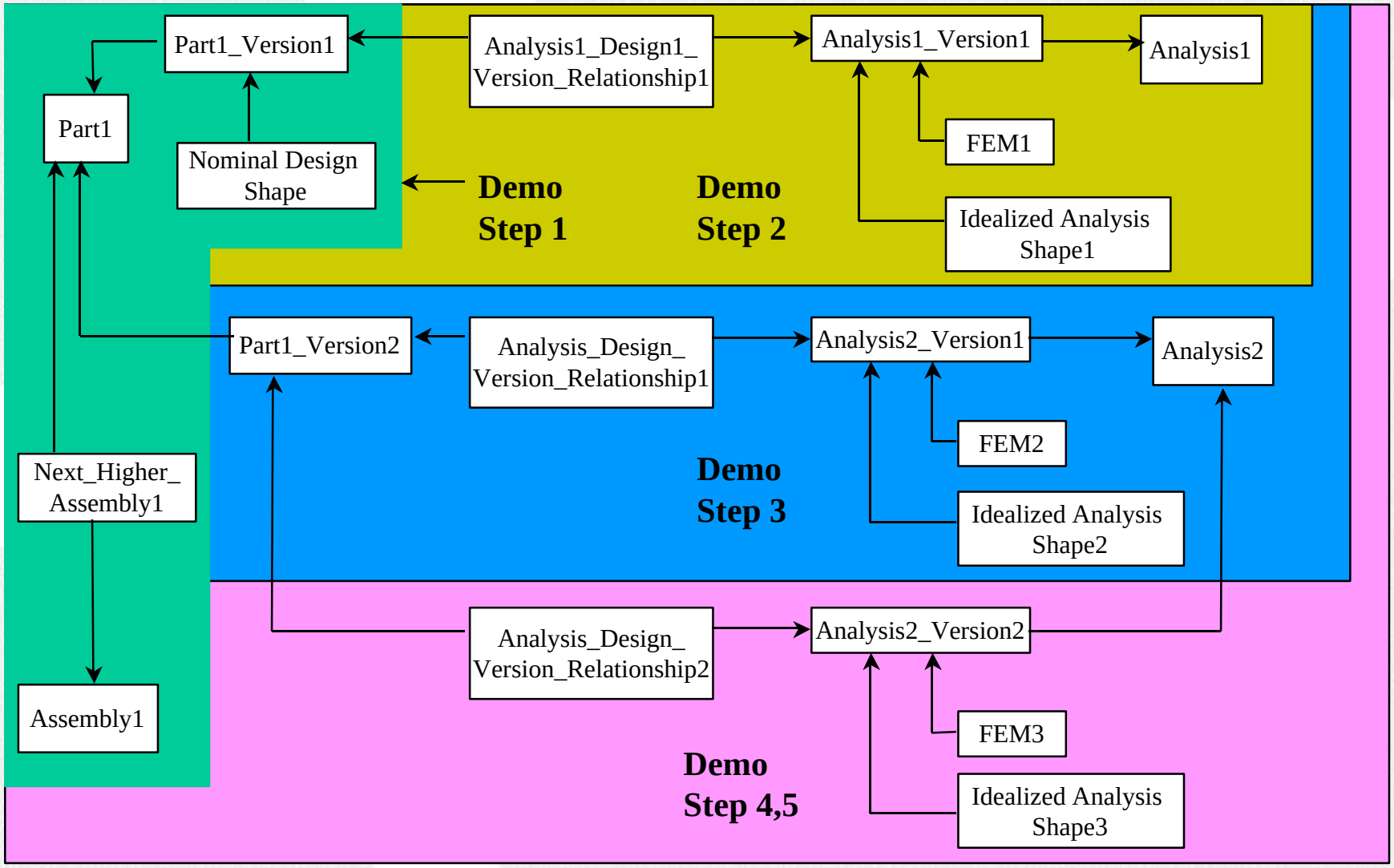
Lockheed Martin Tactical Aircraft Systems

Scenarios for Use of AP209



- First scenario is the iterative design/analysis cycle of a ship deck
- Second scenario is the iterative design, structural and manufacturability analyses of a composite structure

Iterative Design/Analysis Cycle of a Ship Deck

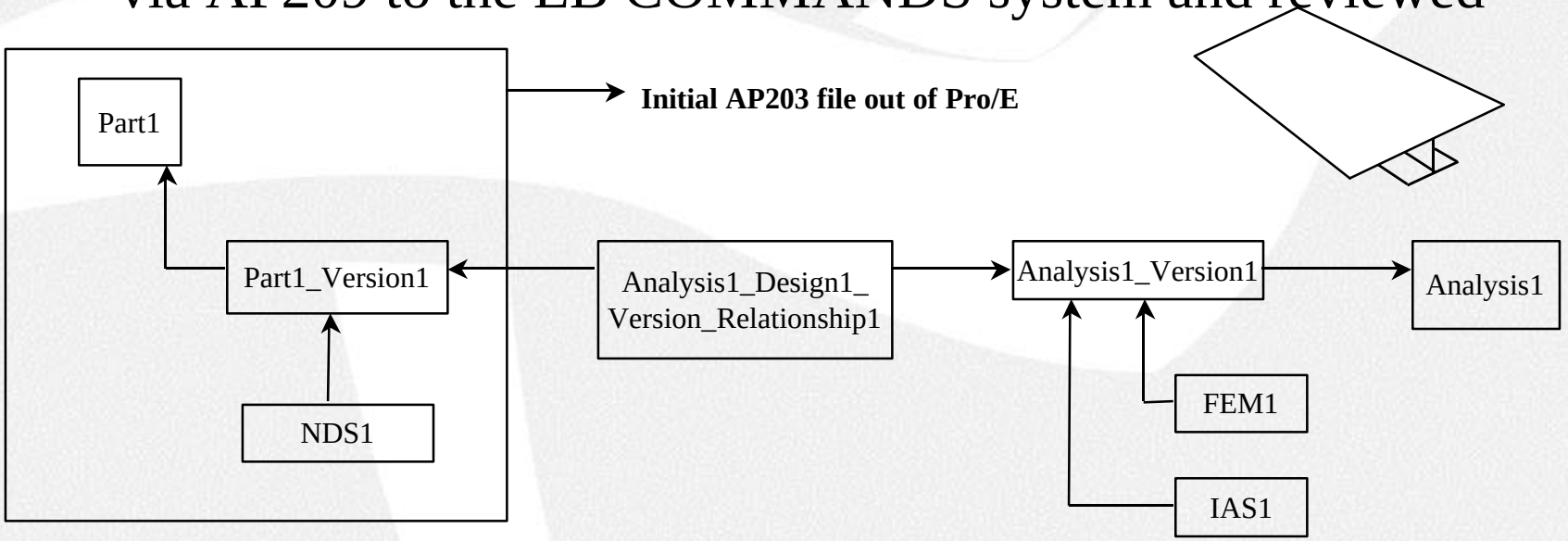


Iterative Design/Analysis Cycle of a Ship Deck

- Based upon the scenario demonstrated at the Fall 1999 PDES, Inc. Technical Advisory Committee meeting
- Key features include:
  - The management of nominal and idealized shapes
  - Multiple idealized shapes
  - Multiple analyses
  - Electronic feedback of analysis modifications to design
- As full AP209 implementation not available so there were some stopgaps employed
  - No CATIA implementation available

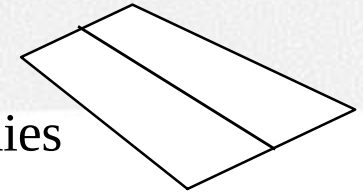
Steps 1 - 2: Import of Geometry from Design and Initial Analysis

- The ship nominal design shape is created in Pro/E and imported into MSC/PATRAN
- An idealized analysis shape with explicit stiffeners and FEM is created in MSC/PATRAN and analyzed
- The nominal, idealized, and FEM information are shared via AP209 to the EB COMMANDS system and reviewed

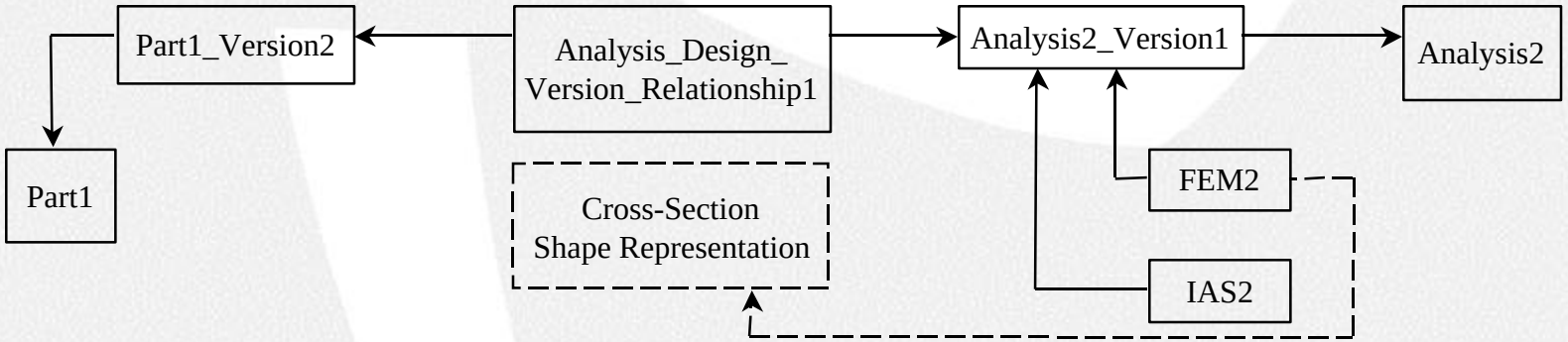


Step 3: Subcontractor Optimization

- A second FEM representation is created in COMMANDS
  - Eccentrically stiffened beams on a shell plate which is more suited to stiffener and plate spacing/stiffness studies

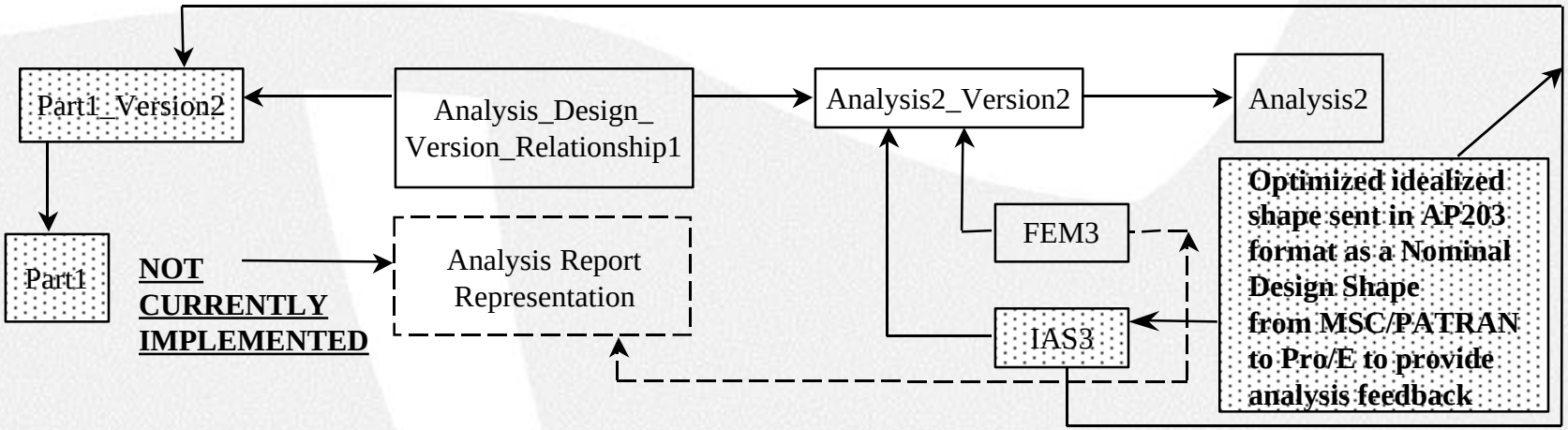


- The optimized FEM and results are written out in AP209 format to feed back design changes to the Prime in MSC/PATRAN
- Due to software limitations the concatenated history of the files cannot currently be performed to demonstrate the true power of AP209 to provide a PDM controlled feedback



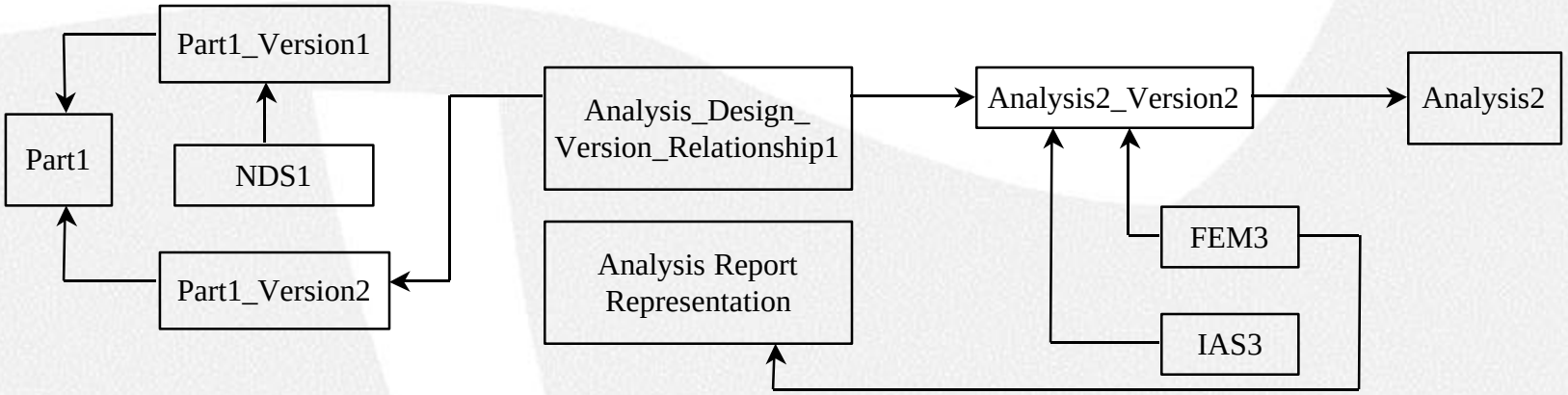
Step 4,5: Final Analysis Check and Feedback to Design

- The beam element stiffened plate model and idealized analysis shape are read back into MSC/PATRAN and an explicit stiffener model created to perform the final check
- With a complete implementation a final repository much like the diagram presented earlier in the introduction would be output, however current implementations are not complete
  - Final shape recommendation fed back to Pro/E in AP203 format (AP203 entities shown patterned - many relationships lost)



A More Complete AP209 Feedback to Design

- The original Part1 and it's nominal design shape (NDS1) for a point of reference (node to hook into PDM)
- Part1_Version2, the final Analysis_Version2 (FEM3) and the idealized analysis shape that reflects the performance requirement changes (IAS3)
- The analysis report containing the rationale documenting the design changes (modes/frequencies, stiffener buckling, model idealization and tuning process)



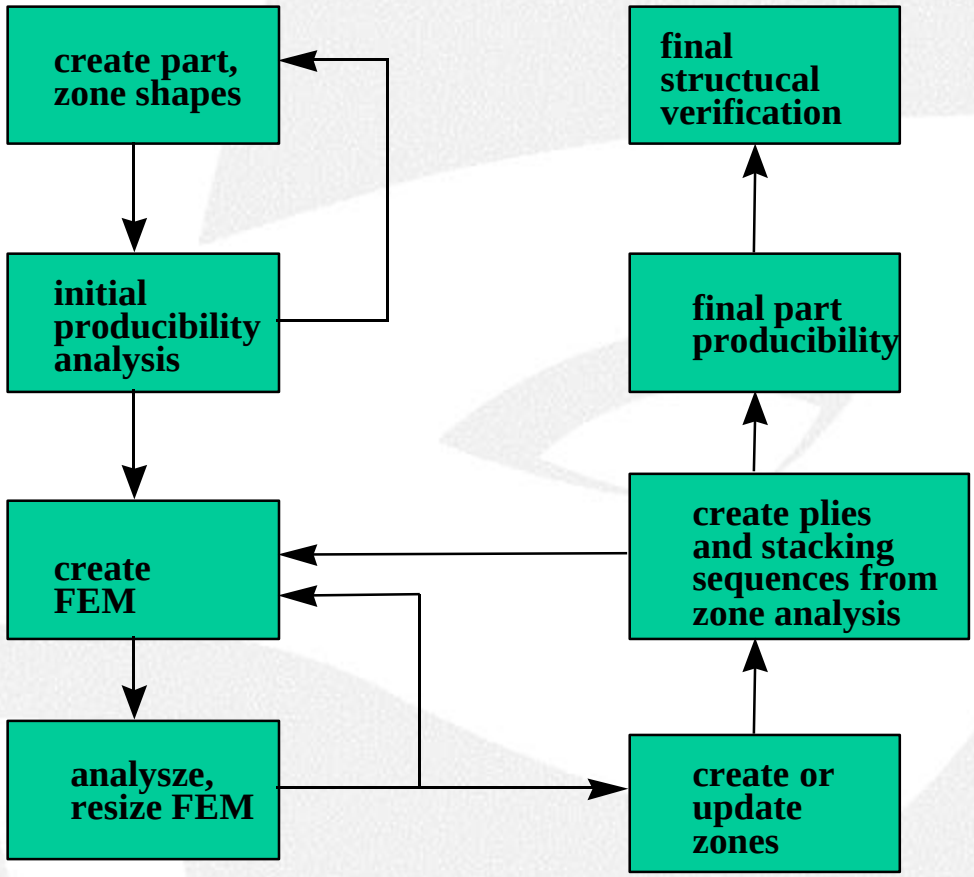
Design, Manufacturability and Structural Analyses of a Composite Part

- Based upon the LMTAS JSF composite design/analysis requirements
- Key features include
  - Multiple nominal and idealized analysis shapes
  - Composite structure and shape sharing
  - Some FEA model/analysis transfer in/out of CATIA if time permits

AP209 - Based Composite Design/Manufacture/Analysis Integration

- Based upon the LMTAS JSF composite design/analysis requirements
- Key features include
  - Multiple nominal and idealized analysis shapes
  - Composite structure and shape sharing
  - Some FEA model/analysis transfer in/out of CATIA if time permits
  - Composite Aircraft Structures
  - CAD/CAM-To-CAE-To-CAD/CAM
  - COTS CAD/CAE (CATIA, FiberSIM, PATRAN, NASTRAN)
  - Lockheed Proprietary AP209 integrated tools (ASSS, PICASSO)
  - Composite Structure Geometric Shapes (Ply/Zone) And FEM/FEA Models
  - Linear Static And Dynamic FEA

High Level Summary of Composite Design/Manufacture/Analysis



Composite Design/Manufacture/Analysis Detail Process Flow